CLAIMS

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. A method for depth-resolved detection of subsurface micro-structure and features in a sample, said method comprising:

a) producing a first illumination of the sample with light possessing polarization in a first direction of polarization;

b) measuring light intensity emanating from the sample that is polarized in a second direction of polarization;

c) allowing the relative position and orientation of the light beam and the sample to change in one or more directions;

d) producing a second illumination of the sample with light possessing polarization in the first direction of polarization;

e) measuring light intensity emanating from the sample resulting from said second illumination that is polarized in the second direction of polarization; and

f) comparing emanating light intensity between said first and second illuminations.

2. The method as recited in claim 1 wherein said illuminating light is provided by a laser.

3. The method as recited in claim 1 wherein said illuminating light is constricted to emanate from a polarization-maintaining optical fiber.

4. The method as recited in claim 1 wherein steps c) through f) are repeated to obtain multiple positions and orientations of the sample and wherein the emanating light intensity with said second direction of polarization is measured as a function of said positions and orientations.

5. The method as recited in claim 1 wherein said illuminating light is expanded by a lens and wherein said illuminating light and said emanating light traverse a polarized beam splitter.

6. The method as recited in claim 1 wherein said measuring utilizes means comprises an optical detector assembly.

7. The method as recited in claim 1 wherein the deflected beam is redirected to successive spots on the sample by means of a laser scan system.

8. The method as recited in claim 1 wherein said measured intensity is multiplied by a factor compensating for attenuation of light within the sample material.

9. The method as recited in claim 1 wherein said sub-surface micro-structure is detected through enhancement of the light intensity emanating from the material with said second direction of polarization.

10. A device for depth-resolved detection of subsurface micro-structure and features in a sample, said device comprising:

a) an initial beam of light polarized in a first direction;

b) a stage that is movable and orientable in one or more directions; wherein said stage is in optical communication with said initial beam;

c) means to deflect said initial beam towards a spot on a sample mounted on the stage so as to produce an illumination of the sample at a first location and orientation of the sample;

d) means to select light emanating from said illumination when said emanating light has a second direction of polarization;

e) means to measure the emanating light intensity from the illuminated spot.

11. The device as recited in claim 10 wherein said initial beam is provided by a laser and is constricted to emanate from a polarization-maintaining optical fiber.

12. The device as recited in claim 10 wherein said initial beam is expanded by a first lens; said deflected beam is focused on the sample by a second lens; and said light emanating from the sample is focused on said measuring means by a third lens.

13. The device as recited in claim 10 wherein said deflection means and said selection means are combined in a polarized beam splitter.

14 The device as recited in claim 10 wherein said measuring means comprises a pinhole and an optical detector assembly.

15. The device as recited in claim 10 wherein said initial beam, deflecting means, selecting means, moving means, orienting means, and measuring means are held in a fixed relation with respect to each other.

16. The device as recited in claim 10 further comprising:

a) means to redirect the deflected beam to successive spots on the sample by a laser scan system; and

b) means to compare the emanating light intensity from said successive spots.

17. The device as recited in claim 10 further comprising means to compare the emanating light intensity from successive illuminations when the location and orientation of the illumination on the sample is changed from the first location and orientation.

18. A device for depth-resolved detection of sub-surface micro-structure and features in a sample, said device comprising:

a) a laser producing a beam of light polarized in a first polarization direction:

b) an optical fiber transmitting said beam while maintaining said first polarization direction such that said beam exits from said fiber as from a point like source;

c) a first lens expanding said beam;

d) a polarized beam splitter deflecting said beam toward a sample;

e) a second lens focusing said deflected beam onto the sample;

f) a stage supporting said sample, said stage movable and orientable in one or more directions so as to vary positions and orientations of the sample relative to the deflected beam, said sample so mounted on said stage in a first stage position and orientation that light scattered from said sample is directed toward said second lens;

g) said second lens collecting said scattered light and directing said scattered light toward the polarized beam splitter;

h) said polarized beam splitter adapted so as to transmit only a portion of the scattered light that is polarized in a second direction of polarization distinct from said first direction of polarization;

i) a third lens focusing said transmitted light through a pinhole onto a detector assembly adapted to measure the transmitted light as a function of said stage motion and orientation;

wherein said laser, optical fiber, first lens, polarized beam splitter, second lens, stage, third lens, pinhole, and detector assembly are held in a fixed relation with respect to each other.

19. The device as recited in claim 18 wherein the deflected beam is redirected to successive spots on the sample by a laser scan system.

20. The device as recited in claim 18 further comprising means to digitize, store, and visualize the measurements made by said detector assembly.